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Measuring Moisture in Wood

From the Editor . . .

There is much anxiety as a result of the recent traumatic events in the USA and their possible link to the economic slowdown. One consequence of this is that discussion of other serious issues we are facing has been swept aside. All of a sudden, it is unpopular if not dangerous to question the status quo.

Regardless of the outcome of the military manoeuvres, there are serious fundamental troubles that have nothing to do with fanatics, but everything to do with our own behaviour. And they will have a serious impact on our industry.

I am referring to the looming energy crisis. Many still do not consider energy conservation and efficiency to be important. The economic boom we've experienced in recent years, with a real drop in energy prices, has meant we've really been deluding ourselves. We've been living in a fool's paradise.

We are consuming energy at an ever-increasing pace. Even if, like the oil and gas industry, you do not accept the findings of scientists around the world that human activity is having an impact on the global climate, there is a black cloud on the horizon. Despite the common perception that we have plenty of reserves of oil and natural gas to last us a long time, I've come across some rather sober facts worth repeating here.

Canada now produces enough natural gas to barely meet current domestic and export demand, which is about 20% of North American gas consumption. Yet gas consumption is growing at about 2% per year (largely to generate electricity). The fact is that there are simply no large new reserves to be found. The largest natural gas find in Western Canada in the past twenty-five years is now being tapped. Experts expect the field to produce about a trillion cubic feet of natural gas. This may seem like a lot, but it represents the gas consumption of all gas-fired homes in Canada for only two years at most. More ominously, the Alberta Energy and Utility Board has predicted that conventional natural gas production will peak by 2003, and then decline by 2% per year.

Over the next decade, Alberta will have exported or burned up about three-quarters of its potential gas reserves. And by 2010, the oil sands are expected to consume nearly 25% of Alberta's gas production to fire boilers to heat the water that melts the tarry sands into usable crude. Ignoring the question whether it is a wise use of natural gas, this will mean higher natural gas prices.

As for other parts of the world, production of gas and oil has already peaked and is slowly declining. The largest reserves are still in the Middle East, but that region has some rather unsavoury and unstable governments. If one or two of these governments fall due to internal social pressures, the cost of having relied on such an energy resource will be astronomical.

What does all this have to do with home building in Canada? Any disruption in the international flow of energy will have a serious impact on our economy. As well, buildings consume about one third of all energy used in Canada. We have the knowledge and technology to build buildings that consume very modest quantities of energy. We can build homes that maximize the use of renewable energy, and that use significantly less energy than even R-2000 homes - if we care to do it.

In many parts of southern Canada it is possible to build homes that don't require furnaces - or at best need only a very small supplementary heater. Despite much talk, we don't see too many such buildings. We seem to prefer to stick to the tried and true approaches. We do only what the code tells us to do, and little more. Like it or not, changes are coming. If we as an industry don't change our ways and produce more energy and resource efficient construction and renovations, these will be imposed on us by external pressures due to climate change and the strategic concerns about available energy resources.

Recent traumatic events and the economic slowdown should be a wake up call. We can either take action voluntarily - as many maintain is the way to do - or it will be imposed on us.

Richard Kadulski,
Editor

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Measuring Moisture in Wood

Moisture in wood framing and other building products is normal. Lumber can absorb a great deal of moisture before its effects pose a risk to the wood and surrounding materials.

The National Building Code of Canada requires that lumber be dry at the time of installation in buildings. Dry lumber is considered to be wood with a maximum moisture content (MC) of 19%. The code requirement is based on long standing experience for average conditions. This is the typical moisture content that air-dried lumber can achieve when it is in covered, outdoor storage.

There is no strict rule for recommending at what moisture content lumber and other materials will be protected against deterioration. We know that decay may continue until the wood is dried to below 20%. When wetted, however, kiln dried wood will not be re-infected by decay fungi unless the moisture content approaches the fibre saturation point (typically 28-30% MC).

Construction practices in the past were more forgiving of higher initial moisture content or the addition of moisture during the building process. Construction scheduling was slower and permitted the gradual drying of the wood frame structure. Lumber sub-flooring allowed the drainage of the rain water that wet the partially completed structure and prevented ponding. Lumber wall sheathing, permeable to both air and vapour movement, resulted in the rapid drying of excess moisture in the wall cavity.

When interior finishes were lath and plaster (a wet process), drying was needed before the final finish plaster coat was applied. This was commonly done after a longer period of time when sufficient drying and building settlement had occurred to allow any cracks due to shrinkage to show up and be repaired before the final finish coat and paint were applied. These building practices are no longer used in North America.

Dry rather than wet practices for interior finishes, the use of plywood and OSB panels, and power tools all provide great flexibility and easy assembly. These in turn have resulted in much shorter construction times.

Shrinkage Is a Consequence of Drying

Whether or not the framing lumber conforms to regulations concerning moisture content, shrinkage still has to be accounted for. Lumber shrinks as it dries. Depending on its location in the building and the climate, the final moisture content of lumber in the building may by 8% or less.

Green lumber can shrink as much as 4.5% (this is almost ½" in a 2x10 piece of lumber). Dry lumber that meets code requirements will experience much less shrinkage but can still shrink about 2%. Longitudinal shrinkage is much smaller (less than 0.1% for the green lumber). Shrinkage can be reduced by using kiln- or air-dried lumber.

Measuring Moisture Content

Two types of meters are typically used on the job site: pin type or pinless. Both types rely on the electrical conductivity of moist wood. They are generally accurate to within plus or minus 1 to 2% MC. In the range of 6% to 12%, pin-type meters are accurate within ½ %, while pinless meters are accurate within 1%. Each is affected by the different attributes of the wood. These attributes must be taken into account to obtain a good estimate of the moisture condition.

The working range is from 5 to 30% MC. Readings are more accurate at the lower end of the range and less accurate as the wood approaches 25% MC. The meters are good for wood up to 50 mm thick. Each manufacturer has slightly different meters, so correction factors and specifications for each unit must be understood.

Given all the potential sources of error that affect moisture meter readings in wood frame construction, the accuracy will typically be within 1 to 4% of the true moisture content for individual measurement. Most of the time a tolerance of 1 to 4% is acceptable for wood framing as the lumber is expected to dry over a period of a few months.

The choice between the two types of meters depends on the type and location of the test to be conducted.

Pin Type Moisture Meters

These meters have two pins that are inserted into the wood. The pins may be part of the meter or may be mounted separately in a probe (connected to the meter via a cable) and are pushed or hammered into the wood. The pins are generally

*The **moisture content** (MC) is the amount of water contained in a piece of wood as a percentage of its weight when completely dry or "oven dry." Green wood from a freshly felled tree may have a moisture content in the range 30-35 % or more, depending on the species.*

insulated along their length with only the tips exposed when in contact with water. The line joining the tips of the pins should be aligned along the grain of the wood. With a pin-type meter, the roughness of the wood's surface does not matter, and even small pieces can be measured.

Proper pin depth is important to ensure a good estimate of the average MC. For lumber 1½ inches thick, the insulated pins of the meter should be inserted to a depth of 5/16 inch (8mm). Usually a good average moisture reading is obtained if the pins penetrate to a depth of one-quarter of the wood's thickness.

Care must be taken to ensure that readings are obtained from sound, clear wood, and special precautions must be taken when dealing with species prone to wet pockets. Several species (balsam fir, alpine fir, hemlock, and white pine) are prone to a condition called "wet pockets," which prevent the establishment of a normal moisture gradient. These are due to a bacterial infection in the living tree, but do not affect wood strength.

If high readings on a single board are found, it is necessary to take at least two more readings at other locations on the same board. Small wet pockets are not a concern because they will dry out.

Pinless Moisture Meters

These meters use sophisticated electronics to sense water inside wood. A sensing pad is pressed against the wood sample, which is not punctured or damaged. Pinless meters are fast in operation, and you can measure large quantities of wood quickly by sliding the sensing pad along the length of each board. These meters are essential for some applications, such as testing finished wood or antique furniture, building inspections, or in any situation where the holes made by pin-type meters are not acceptable. The surface must be smooth and flat, however, or there will be poor contact between the sensor pad and the sample, resulting in a moisture reading that is too low.

Guidelines for On-site Measurements of Moisture in Wood Building Materials Prepared by Forintek Canada Corp. For Canadian Mortgage & Housing Corp. and the Canadian Wood Council

Adjusting for Temperature

The temperature of the wood and the air needs to be known because the electrical resistance of wood decreases as the temperature increases. To get the most accurate predictions of MC, meter readings must be corrected for the effect of temperature and species. Over the range of -30°C to +50°C, for every 10° C rise in wood temperature the meter reading increases about 1.1% MC. For example, in some commonly used meters a reading of 11½% on Douglas Fir at 20°C represents a moisture content of 15%. In some meters, the temperature and species correction is applied internally.

Attention to temperature is important, as there can also be significant temperature differences within a building. In the afternoon, a stud on the south side of a building will be much warmer than a sill plate on the north side in the morning.

Adjusting for Species

All moisture meters are calibrated for a particular material at one temperature condition. The industry standard is Douglas Fir. Different species of wood have different properties that will influence their electrical resistance. If the wrong species correction factor is applied, the MC estimate could be off by up to 6%. This means that meter readings may have to be corrected. For some meters, correction tables may have to be checked. Others may have built-in correction factors.

Forintek has published moisture content tables for the Delmhorst moisture meter, but most manufacturers supply correction factors with their units.

The grade stamp will identify the species grouping and the general area of the country where the material originated. When an individual species cannot be determined, then a combined or "average" correction factor for the species grouping should be applied. The error will generally be within 2% MC.

Treated Lumber

The most commonly used treated wood is copper chrome arsenate (CCA). CCA wood is dried, then pressure treated in a water-borne chemical solution. The S-DRY stamp on pressure treated lumber is not indicative of the moisture content after the treatment. If used in a building, kiln drying after treatment (KDAT) should be specified.

Borate Treated Lumber

Borate treatment is also a water-borne process, but borate treated wood is intended only for applications protected from rain. All borate treated wood should be specified as KDAT. The treatment will also prevent decay and reduce the risk of mould growth.

Currently, little is known about the effect of the treatment on the moisture meter correction coefficients.

Equilibrium Wood Moisture Content

RH %	10	20	30	40	50	60	70	80	90	100
MC %	3	5	7	9	11	13	15	18	23	35

Moisture content wood achieves at relative humidity (average RH over long term).

Meters can also be used on products such as plywood and OSB. For solid wood treated with preservatives or fire-retardants, however, there is limited information available on how to interpret readings, so these can only suggest the range of moisture content.

Sampling Wood Framing

Accurate meter readings are important. Knowing where to take readings and how to interpret them is equally important.

Moisture by rain or snow or through contact with wet concrete can get into the framing. This means that whatever the moisture content of the individual pieces of lumber before construction, the quantity and distribution of moisture may be altered during construction.

Panel sub-flooring does not drain, so ponding of water is common on floors exposed to rain or snow. Concrete toppings also add to the moisture load. That is why bottom wall plates and the bottom end of wood studs are vulnerable to soaking up and retaining water.

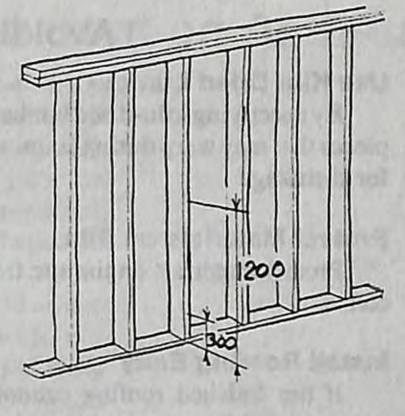
The more critical elements to measure are exterior wall studs and plates, as these are generally more exposed to the weather and must be built to be resistant to moisture flow. The wall studs on interior walls are usually only enclosed with gypsum wallboard which allows drying so the moisture content of interior studs is not as critical to durability.

If the intent of the moisture measurements is to find out whether it is acceptable to close in the framing, a minimum of 4 studs should be measured in each wall elevation. Two sampling locations at two depths at each location, measured at two heights are recommended. Four studs in a wall should be measured, for a total of 16 readings at a level about 300 mm and at mid height. This should give a good estimate of the moisture content in the studs.

Although a pin depth about 5/16" is recommended, it is a good idea to check the core moisture content as well. If the surface is relatively dry, but the core is wet (more than 25% MC), this suggests that wet lumber was used and it is drying. If the surface is wet and the core is drier, re-wetting during construction is more likely.

The bottom plates are likely to be the wettest of the framing lumber in the building and should be checked more rigorously - on the surface and at the core. The bottom storey will be the wettest even though it will have been built first and, in theory, has had an opportunity to dry out.

Headers, rim joists, built-up columns or other elements with a large mass of wood are slow to dry when wetted.



Types of Wall Systems

Some wall systems dry better than others. Most wall systems in Canadian climates are built with a vapour barrier placed over the interior surface of the framing, just behind the interior gypsum board. Moisture can only dry toward the exterior after the installation of the vapour barrier. The polyethylene vapour barrier also serves to protect the gypsum board from moisture in the wall.

Orientation

The drying rate will be affected by the orientation of walls in relation to solar gain, and in relation of the prevailing direction of wind-driven rain. Orientation should be accounted for in design and predictions on the time required before closing. North facing walls and walls shaded from the sun by other buildings can be expected to dry more slowly. ☼

Avoiding Moisture Problems Before They Start

Use Kiln Dried Lumber

By specifying kiln-dried lumber, you limit the number of pieces that may warp during framing and reduce the potential for shrinkage.

Protect Materials on Site

Protect materials on the site from rain and from ground contact.

Install Roofing Early

If the finished roofing cannot be installed soon after erection of the roof sheathing, then apply a roofing paper membrane over the entire roof immediately after, or as part of, the installation of the structural roof sheathing.

Sheathing Panel Orientation

Panels applied horizontally must be spaced to allow for expansion. This satisfies the building code requirement for a gap permitting indoor humidity to escape. Some builders have been leaving larger gaps between the panels on the assumption that this would allow the structure to dry more quickly. While this may help sometimes, any water that runs down the outer side of the sheathing could be intercepted by these gaps and be directed into the wall.

Builders who orient structural sheathing vertically and use a moderately thicker sheathing to avoid buckling between studs find that this provides a continuous surface that can better shed rain and prevent excess water from entering the uncompleted structure.

Install Sheathing Membranes Early

Early application of sheathing membranes to the partially completed structure will help shed rainfall. Since scaffolding for the installation of finished cladding is not erected until that segment of construction is scheduled, the practical way to apply sheathing paper is when the wall is first built before it is tilted into position. Doing this requires careful planning and a rethinking of what the individual trades are required to do.

Cover Window and Door Openings

To keep out rain, but still allow daylight for workers, cover window and door openings with a translucent membrane.

Sequence Concrete Topping Pours

The bottom wall plates in buildings in which a concrete topping will be poured onto wood floors are more likely to retain moisture if they have not been allowed to dry before placement of the concrete. The bottom wall plates, especially if doubled, are likely to have extra moisture that they have absorbed when wetted by rain. Where possible, the sides of wall plates should be protected with a membrane before pouring the concrete.

Early sequencing of pours is preferable to allow the construction moisture to dissipate before dry and finishing materials are installed.

Some builders choose to use treated wood for the bottom wall plates when concrete topping is applied to provide them with protection against decay caused by excessive retention of water. However, if treated wood is used inside the building, it should be borate treated.

Install Vapour Barrier Late

Install vapour barrier late, so it doesn't impede drying of lumber and other components that got wet during construction. Install cladding late, as it can impede drying of lumber and other components that got wet during construction.

Use Heating and Ventilation Equipment to Dehumidify

Once the building is closed in, install ventilation equipment to speed up drying at an early stage. Heating the building at an early stage can also be beneficial, but the heat must be dry. Open propane fried heaters generate moisture and should not be used.

The Effect of Improving the Home Environment on Asthma

We now know that poor indoor air quality will affect human health. Studies in various countries have shown that dampness, moulds and other contaminants in houses are linked to respiratory health. The relationship between health and specific indoor contaminants is not well understood. However, it is important for everyone, especially the increasing number of people who suffer from asthma, to understand the extent that poor indoor air quality in the home contributes to health.

Asthma and other forms of respiratory ailments affect about 20 percent of the population in Canada. Evidence indicates a direct relationship between the health of patients with lung disease and the quality of air in their homes. Increased asthma problems have been reported when a person moves into a new home or carries out a renovation project. As well, improvements to health have been noted when the air quality in a person's living environment has been improved.

Indoor air quality researchers have long believed that improvements to the indoor air quality in the home can have a positive impact on the health of the occupants. Up to now, most reports relating to indoor air quality problems and lung disease have been anecdotal.

A pilot study done in Ottawa for CMHC looked at the impact on health of when improving the home environment. Before doing renovation work, the indoor environment in each house was assessed and detailed health information was collected from the occupants collected. This included tests to measure the presence of mould, fungi and other contaminants. Recommendations for renovation and clean up work were prepared, but it was up to the owner to arrange to do the work. After the work was completed, the indoor environment was evaluated again, and health information collected.

Air samples were tested for a number of mould types and the results were given a pass or fail. To fail there had to be more than one colony forming unit (cfu) of toxic moulds like stachybotrys chartarium, aspergillus versicolor, aspergillus fumigatus, fusarium moniliforme, or high mould counts (more than 150 cfu/m^3).

Most air samples failed the Pass/Fail criteria for contamination because of the presence of moulds. Many moulds, other than the typical outdoor moulds, were found in all houses. Basements were the most significant sources of moulds in all homes tested.

The recommended work involved cleaning up areas where mould and fungi were observed. In all cases the work involved extensive cleaning and, for two houses, gutting and removal of partition walls and flooring in the basement. In some cases, it was recommended that ventilation be improved by installing a heat recovery ventilator.

Furnishings had to be decontaminated in the same way as the building; otherwise, mould was would be reintroduced from those sources. A basic requirement in all houses for participation in this study was the disposal and decontamination of materials stored in the basements.

Indoor air quality was examined at least one month after the completion of the final inspection, and after the houses had a chance to achieve a new equilibrium condition.

The study found that reductions in the mould contamination of the house resulted in positive benefits to the asthma patient. This was seen by the reduction in the frequency and severity of asthma attacks and the need for medication. The improvement of the air quality in the house made the asthma more manageable for most of the participants.

The remedial work resulted in a significant reduction in the level of moulds and fungi detected. However, some toxigenic fungi were still present in most of the houses after the clean up and renovation work. Air samples still failed the passPass/fail Fail test for mould. It was found that, despite all the information provided, not all the home owners did not do all of thecompleted the recommended remedial work. Where In instances where only clean clean-up was done, without remedial work to control moisture entry, the mould reappeared.

This study shows that proper remedial work will improve the indoor air quality, but getting a homeowner to carry it out is something elseanother challenge. ✪

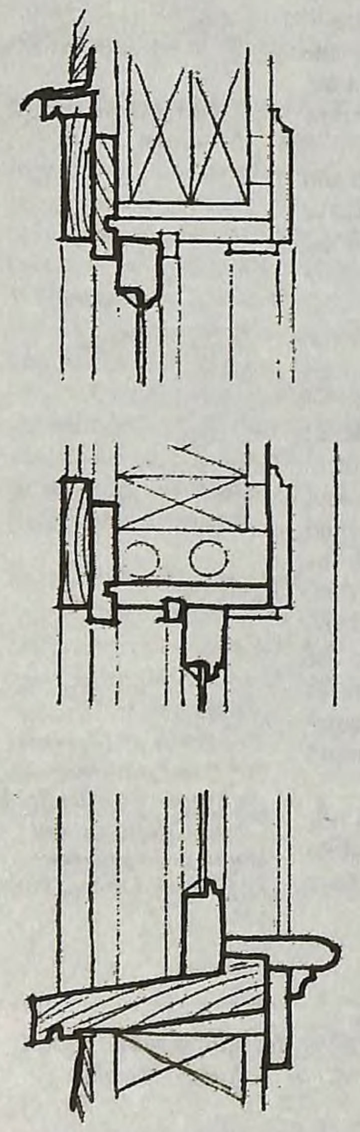
The Effect of Improving the Home Environment on Asthma: A Pilot Study
Canada Mortgage and Housing Corporation
by Buchan, Lawton, Parent Ltd

☞ *Pressure-treated wood, though chemically treated against mould or rot, was found to support the growth of toxigenic moulds.*

☞ *It is evident that ventilation by itself cannot be relied on to solve indoor air problems.*

Leaky Windows

It's been known for some time that windows can leak because of the way they're designed and installed. In British Columbia, this realization has hit hard in recent years. However, window design and installation concerns are similar regardless where you build. The disheartening thing is that this problem was known many years ago. This article is a summary of a Building Practice Note published by the National Research Council. For many building professionals (designers or builders), it may come as a surprise that this note was issued back in 1983, although it could just as easily have been written in 1999!



Detail of typical older wood frame window. Note head flashing (top), pronounced sill (bottom)

Rain leakage will happen if there is water on a wall, if there is a path for the water to penetrate the wall surface, and if there are forces to drive water inward.

Water on a Wall

It is a certainty that at some time there will be water on a wall surface. Older houses generally had large roof overhangs that protected the walls from wetting, unless there was wind driven rain. At wind speeds of less than 20 km/h, rain will drip almost vertically from the edge of an overhang if there is a reasonable drip edge.

Flashings are designed to act as a drip edge. They are not effective when they are cut back, flush to or behind the surface. Strange as it may seem, this has often been done to make them inconspicuous.

Leakage Paths

The forces that cause water penetration at openings are the kinetic energy of the rain as it is driven by wind, the difference in air pressure across the opening from outside to inside, gravity and capillary forces acting on water that bridges an opening. Since these forces are normally present together, water penetration will almost certainly take place if there are leakage paths.

Water- and air tightness of exterior walls is difficult to achieve and maintain. Small amounts of rain leakage may be tolerated without any serious deterioration if there is an opportunity for the construction to dry out between occasional wetting. In well-insulated energy-efficient walls, drying potential is reduced, so could produce an additional risk of moisture damage caused by rain penetration.

Since the 1970s, there has been an attempt to simplify details and produce less expensive windows. In the process, designers and manufacturers have ignored important design details that were evolved over hundreds of years of building practice. Older wooden window designs have a drip cap and flashing at the head of the window sloped to control water movement. The sill is steeply sloped to drain water away. The sill also projects past the face of the cladding. These sills also have a drip edge to prevent water from moving back under the sill.

Today's windows will have leakage problems when exposed to wind and rain. Newer windows have simplified profiles, with sills that have only a slight slope on the top with only a horizontal underside that has little deterrent to water flow back into the building. This results in relying on caulking to maintain water tightness. Caulking between the sill and exterior cladding might be effective for a short time, but a properly designed detail should work without relying on caulking. Any building movement will create forces on the casings and open up leakage paths.

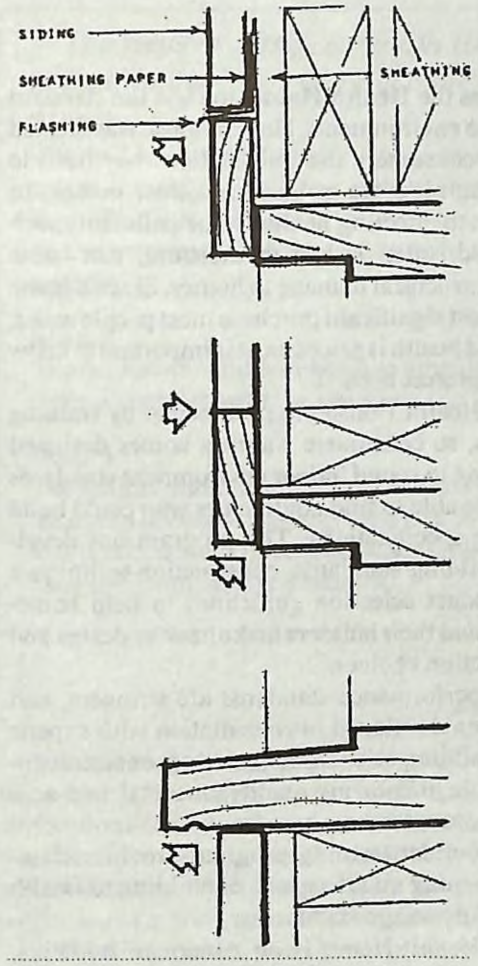
Simplified joinery details that use butted joints commonly used also allow easy water penetration from outside to inside and create air leakage paths for heat loss.

Most windows today have vinyl or metal frames that are simpler than even wood frames. A single extrusion is used for head, jamb and sill. For many windows, the edge of the sill does not project outward enough to allow water to drip clear of the joint and the wall.

Drain holes are provided in the upturned lip of the sill, but the sill itself will not direct water away from the joint at the exterior wall finish. The large upstanding lip at the head detail will create a water trap if the flashing is inadequate, or if no flashing is used.

Sheathing paper must also be installed correctly. It must be lapped to shed water. The sheathing paper must overlap the flange on the frame at the head and jamb, but the flange must overlap the sheathing paper at the sill.

Rain Leakage of Residential Windows in the Lower Mainland of British Columbia by T N Blackwall and M C Baker, Building Practice Note 42, National Research Council, 1983.



Recent wood window designs. Potential points for water entry are noted by the arrows.

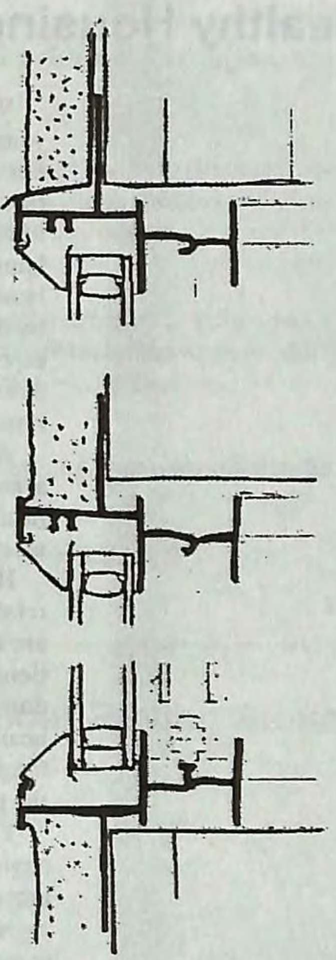
Flashing

Most windows can function satisfactorily without head flashings if they are protected by overhangs or are in sheltered locations. A rule of thumb for overhangs is that head flashings can be ignored if the roof overhang projects from the wall at least four times the distance between the fascia and the top of the window trim. The flashing must extend at least 50 mm up behind the building paper.

Caulking

Caulking is normally used between masonry, siding or stucco and the window frames or trim, including sills, unless these locations are completely protected from the entry of rain. However, caulking has limited life, especially when exposed to the weather. Caulking is not intended to be the prime way of preventing water penetration. Narrow spaces are hard to caulk effectively and do not perform well, so caulking may not always be effective in preventing water penetration for a long time.

The water shedding function of building paper and flashings must be ensured. Caulking may help eliminate problems, but if used it must be maintained regularly. When problems do occur, they are usually serious and result from ignoring the simple facts about water penetration. ☼



Typical flange mounted metal or vinyl wondows. Note limited flashing protection and no projecting sill.

R-2000 Healthy Home Sells for More than Asking Price

It has often been stated that an R-2000 home will increase in value because it is built better. A significant challenge for R-2000 builders has been the lack of evidence of price appreciation due to the small turnover in R-2000 homes – whose owners simply stay put. Consequently, there is little hard evidence to prove that R-200 homes actually do increase in value.

A recent sale in Vancouver provides evidence that there is merit to the claim that R-2000 homes increase in value. An R-2000 Healthy Home built by Wisa Healthy Homes has just been resold to a Vancouver physician for $20,000 more than the price listed by the realtor, and for $50,000 more than the price the first owner paid in 1997. The purchase was made because of the R-2000 features in the house. ☼

Healthy Housing

Whether castle or cottage, in the city or country, your home is your sanctuary. It's a place to raise a family, entertain friends, live, and more often these days, work. Canadians spend an average of 95% of their time indoors, most of that time at home, in what is usually viewed as a safe haven. However, evidence suggests that some homes may be detrimental to the health of their occupants, especially those with compromised lung function due to age, asthma, chemical sensitivities or other respiratory conditions.

Asthma rates in particular have been increasing at an alarming rate in recent years. This is a concern in all developed countries. Today, asthma is the most common chronic illness among children.

Home pollutants such as dust mites, animal-related allergens (dander and saliva) and mould are known asthma triggers, while high accumulations of carbon monoxide, formaldehyde, and radon in inadequately ventilated homes are serious health hazards. The media regularly report on families experiencing deteriorating health due to the presence of mould in their airtight houses.

The first step toward creating a healthier home environment is to understand where the problems are and why. Due to changes in construction materials and building practices, homes have become considerably tighter in the past few decades. This has resulted in lower air change rates and a marked increase in indoor pollutants.

For homeowners or renters in existing residences, eliminating sources for indoor pollutants is the key to creating a healthier environment. Common pollutants include: carbon monoxide, formaldehyde and other volatile organic compounds (VOCs), radon, biological contaminants such as mould, bacteria, dust mites, pet dander and pollens, and environmental tobacco smoke (second-hand smoke).

Major renovation or remodelling projects provide an ideal opportunity to look at moisture, ventilation and filtration conditions to ensure an optimal home environment.

Educational materials and services to help consumers and builders address that this growing problem are available, specially through CMHC and their Healthy House initiative.

In the USA, the American Lung Association of Minnesota has developed a national program, known as the **Health House**, to raise the standard for home environments. Health House was created to give consumers the information they need to maintain, renovate or build healthier homes. In addition to affecting health, some pollutants such as mould, often linked to moisture, can cause serious structural damage to homes. Since a home is the most significant purchase most people make, and good health is priceless, it is important to know how to protect both.

The Health House program began by training builders, so consumers wanting homes designed according to sound indoor environment standards would be able to find contractors who could build to those specifications. The program has developed building standards, construction techniques and product selection guidelines to help homeowners and their builders make healthy design and construction choices.

The performance standards are stringent, and have been developed in consultation with experts in the building science, engineering, environmental health, indoor air quality, medical and academic communities.

The builder-training program provides classroom training on all aspects of building to Health House Advantage standards.

The Health House is an American initiative. However, it is a direct copy of the R-2000 Program, and has been based on R-2000 experience. More than 130 demonstration houses have been built across the USA.

The R-2000 performance criteria are closely linked to energy efficiency, since energy efficiency was the reason behind the development of the program. But we know the benefits go far beyond simple energy efficiency. We have evidence that homes meeting the R-2000 performance requirements have a beneficial impact on their occupants' health.

As the American Lung Association has identified - there are improvements that builders can do to create a healthier home environment. If, despite changing energy prices and environmental concerns, builders are still having a challenge with the historical focus on energy consumption, why not reposition the marketing of the R-2000 home as a healthy home? ☼

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

r.2000@nrcan.gc.ca
http://oee.nrcan.gc.ca

The steps to certify a Health Home are identical to those an R-2000 builder must follow. The difference is that, in the USA, there is a fee associated with each step.

Step 1
The builder attends Health House training, where he receives training in building science, marketing and education. The builder is also given a builder's manual, a listing on the program's Web site and climate specific performance criteria.

Step 2
The builder commits to build to Health House criteria and signs a contract with the program.

Step 3
The builder submits blueprints and a construction checklist for a plan review and energy analysis. A review of blueprints and products used in construction is done to ensure compliance to Health House standards.

Step 4
Site inspection is done at three key points in the construction process. These include foundation, framing and insulation and mechanical system inspections.

Step 5
Final performance testing and inspection are done and a final report is written. Tests include blower door, duct tightness and depressurization.

Step 6
When Health House is complete, a plaque is awarded to the homeowner

Total cost? $ 2,250.00 (and that is US $!)

A Green Alternative: Recycled Rubber Paving Stones

Efforts have been made for some time to recycle tire rubber. The challenge is to find appropriate applications for the recycled material. As a product, tire rubber is extremely durable and does not readily biodegrade. Because of off gassing, tire rubber is not a good material for indoor use.

Rubber tire pavers were used for the outdoor patio at the BC Advanced House in 1993. The manufacturer at the time made paving stones that matched conventional concrete pavers in size and thickness, which made them heavy and difficult to work with. Despite their best efforts, the manufacturer was not successful at developing a market for their product and ceased production.

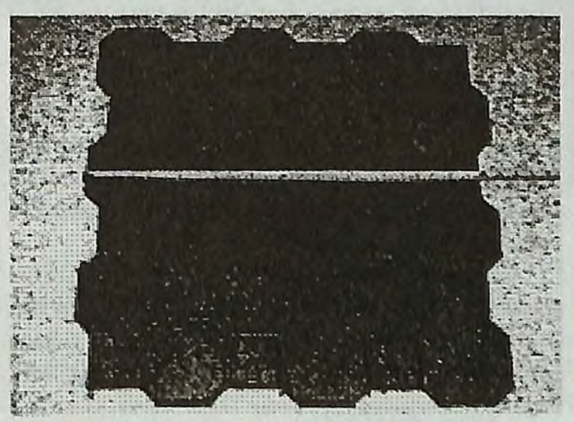
Now a Saskatoon company has developed a new paver product. The Shercom paving stones are mats rather than bricks. Each is made from 100% recycled rubber and is the equivalent of one recycled tire. Each interlocking mat has the appearance of 18 individual paving stones, but is a more continuous weed barrier because there are fewer actual cracks in it.

The 2' x 2' mats are only 1" thick. The thin mat makes it easy to cut with a utility knife compared to a mason's saw needed to cut concrete pavers. Each mat is light-weight, and can be handled by a single individual. The mats can be installed or adhered over top of existing surfaces such as wood, concrete, sand, or soil. They are manufactured in colours that match common concrete pavers (tan, red, brown, buff, grey, and black).

Because the pavers are flexible, they allow for small variations in the subsurface without rocking or being shifted out of place. They offer a non-slip, soft, play-safe rubber surface.

The durability of rubber means the pavers are resistant to corrosion from salt, water freeze-up, or rot. Compared to wood or asphalt, they are non flammable

At a retail price of less than $4.00 per sq. ft. (depending on colour), this product presents a cost effective "green" alternative to conventional paving stones. ☼



Information:
Shercom Industries
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Fax: 306-665-6606

Technical Research Committee News

Canadian Home Builders' Association

Coming Code Changes

Rain Screen Envelope Construction

Code changes are being drafted to deal with the major concerns that have been identified in recent years. Especially in coastal regions, on both the Atlantic and Pacific, there is a need to better define building envelope requirements to ensure that durable building envelopes will be built. The rain screen concept has been identified as the most effective approach for such challenging environments.

The Standing Committee on Houses, the group responsible for the Part 9 provisions of the National Building Code, has accepted a recommendation to introduce requirements for rain screen construction in certain climate zones. Climatic data is being evaluated to define the climate zones in which such construction will be required.

Ventilation Requirements

The Task Group on Section 9.32 (Ventilation Requirements), has developed a revised version of the ventilation requirements. The revision will add a prescriptive, exhaust-only option acceptable for use where there are no spillage-susceptible appliances and no known soil gas conditions. These new requirements will be tested prior to implementation to ensure they are easy to follow and functional.

These and other proposed changes will be included in the public review process that should be available next year.

Energy Analysis Software

Our love affair with the computer is not over. New, more sophisticated tools are being constantly developed and improved. Increasingly, we rely on the computer for everything. As builders know, the right tools for the right job can make life easier. But as anyone who uses a computer also knows, although computer software can be wonderful, it has to be suited to the job and used correctly. Computers and computer software are merely another tool on the tool belt.

HOT-2000 energy performance software was initially developed for the R-2000 home program as a design tool and for verifying compliance with performance requirements. The core of this software has now been adapted for other applications, including Energuide for Houses, and for evaluating compliance with the Model National Energy Code for Houses. There is now a family of software products for various applications developed and maintained by the Buildings Group at Natural Resources Canada. Anyone interested can access and download the software, at no cost, from NRCan's web site: *www.buildingsgroup.nrcan.gc.ca*

Interested builders may find some of the programs useful for assessing new construction details, and as a sales tool for upgrading to more energy efficient construction.

However, a word of warning: the saying "garbage in, garbage out" still applies. Anyone planning to use software, for whatever purpose, should take the time to become familiar with it and understand its features and limitations before counting on the results. The help files and tutorials that accompany the software will provide a good starting point for those new to a program. ☼

Construction Materials Compatibility

Using incompatible materials can result in the deterioration of one or both of the materials. Manufacturers' literature generally provides information about materials that may be incompatible, but where several trades are involved, incompatibility issues may be overlooked. Polygon Homes, a major home builder in the Vancouver area, has identified this as an issue of concern and has developed a bulletin for the use of its staff and their sub trades.

Some combinations of materials that can cause problems after construction include:

Asphalt and polyurethane
Aluminum and galvanized steel
Aluminum and concrete
Cedar wood and polyolefin building wraps

Bituminous roof patch and SBS torch-on membranes: solvents and oils used in some bituminous roof patching materials can dissolve or weaken the composite membranes.

Wood treatment and uncoated fasteners: mineral slats may induce corrosion to uncoated fasteners and nails. This is especially pronounced with borate wood treatments that are applied to moist wood.

Polystyrene and polyurethane caulking: Solvents in caulks may soften or dissolve the polystyrene. This is especially a problem with exterior insulated finish systems (EIFS), which is why EIFS manufacturers require that the insulation board be fully covered by the base coat before any caulking is applied.

Polyethylene and polyurethane caulking: Peel-and-stick membranes or poly-vapour barriers terminate in locations where they must be sealed to adjacent materials. Polyurethane adheres well to many materials, but not to polyethylene.

Silicone caulking and concrete materials: Silicone is a good material, but adheres poorly to many materials, especially where there is movement or improper surface preparation. Other caulking materials such as polyurethane will not adhere after silicone has been applied to a joint surface.

Treated wood and galvanized or uncoated fasteners: Wood treatments are corrosive to galvanized or uncoated common nails and fasteners. Stainless steel fasteners are recommended for use with treated wood products.

Soft vinyl (PVC) and peel-and-stick membranes: Some window manufacturers caution against using peel-and-stick membranes when in direct contact with vinyls and PVC products. The concern is the discolouration and staining of some of the vinyl materials. The weakening of soft vinyls with plasticizers has been reported as well.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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The Affordable Home

Economic restructuring, demographic shifts, and lifestyle changes mean that we live in a different world today than that of the traditional family of the 1950s and '60s with its single breadwinner, stay-at-home mother and two or three children.

But has our housing changed that much? The typical post-war house of the late 1940s had about 900 sq.ft. By 1955 it had increased to 1,100 sq.ft., and by the mid 1980s it had grown to about 2,000 sq.ft. During this same period, household size had shrunk from 3.9 people to 2.5 in 1998.

Houses today are not only larger, but are also loaded with features and gadgets and expensive "warehouse" space in which to store them. In the kitchen alone space is needed for juice makers, pasta machines, bread makers, popcorn poppers, cappuccino makers, food processors, and the many other appliances and items bought on impulse or received as gifts and destined only to be used once then buried in a cupboard. Today's walk-in closets are often larger than whole bedrooms in the past. At least one bathroom will have up to five fixtures, and many houses have one bathroom for each bedroom. All of the above contribute to the total cost of today's house.

In addition, infrastructure costs are now tacked on up front, adding to land costs. Large lots naturally add to that cost; a foot of frontage can easily cost $500 to service. Smaller lots - the very characteristics that make older neighbourhoods so attractive, seem to be challenged in new developments. Municipalities pay lip service to common sense and good design principles but bow to NIMBY (Not In My Back Yard) pressure with its insistence on bigger lots and wider streets than necessary, thus adding servicing costs to the lots.

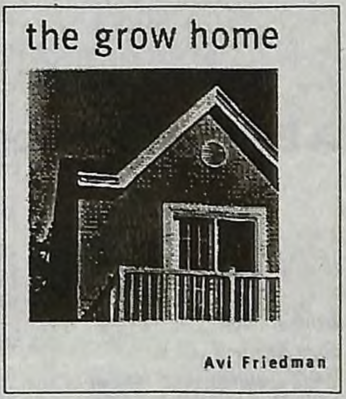
Avi Friedman and Witold Rybczynski at the McGill School of Architecture in Montreal have not only challenged what has been happening in the housing market, but have been able to design and see thousands of units of affordable housing built in the past decade - mostly in the Montreal area.

The idea for the Grow Home, as it has been called, was spurred on by the challenge to create a house that could be sold for $70,000 (land included). The Grow Home shows it can indeed be done for such a seemingly impossible price tag. The many homes built have been done strictly within the bounds of this price structure.

Much has been achieved through design innovation, and a willingness to approach home design and construction detailing by pushing the limits of conventional building wisdom. The 1,200 - 1,500 sq. ft. homes are attached row houses, but each has its own identity and yard space. Not only are these homes affordable and attractive, but they are also energy efficient.

The design process and the challenges faced by the design team are described by Avi Friedman in his very readable book "The Grow Home". A lot of the discussion deals with the social context of housing - how people use their houses - and the changing makeup of the population. We often get too bogged down in our own business to step back and look at what changes have occurred in the broader world and how these

Continued on page 15



The Grow Home, by Avi Friedman, McGill-Queen's University Press

Air "Purifiers"

As health concerns gain in prominence, so does interest in indoor air quality. We know that many otherwise unexplained physical ailments such as allergic reactions or flu-like symptoms can be traced to airborne pollutants in the home or workplace.

This has led to increased interest in devices to "clean" indoor air, and to a proliferation of filter technologies. Each may be effective in certain situations and under certain operating conditions.

One "air cleaning" technology that has a high profile, and is still aggressively marketed, is the ozone generator. Ozone generators may have limited application in special circumstances, but at no time should they be used in occupied spaces.

Ozone can be effective in removing contaminants by plating them out on surfaces. The theory is that the ozone removes air pollutants by oxidation. Unfortunately, ozone is also an irritant to the human body. That is why Health Canada guidelines exist for acceptable ozone limits. The Workers Compensation Board in BC does not allow the use of ozone generators in occupied spaces. By law, ozone generators can no longer be sold in the USA as air purifiers.

Despite the known concerns and restrictions on their sales in the USA, it is disturbing to see that ozone generators are still being sold for household use in Canada. Our regulations apparently do not have the same clout. At a recent consumer home show, I observed these units being aggressively promoted. The sales literature states, "Generated Activated Oxygen (ozone) seeps into crevices, carpets, drapes and furniture and removes pollutants in the air by oxidation." No mention is made of the hazards to humans.

This is an example where more stringent and enforceable regulations are appropriate, although in the current anti regulatory climate this is not likely to happen. ☼

Indoor Air Quality: It's not Just an Indoor Pollutant Source

The quality of indoor air is affected by outdoor pollutants that are brought into the house. Even a well built and properly maintained house can be compromised by contaminants from outdoors. A recently published paper in the Environmental Health Perspectives journal reports on a study funded by the US EPA which shows how commonly used garden pesticides and weed killers are tracked and distributed throughout a house.

The study measured the distribution of the herbicide 2,4-D in the air and on interior surfaces (floors, table tops, and window sills) after it was applied to the lawns. 2,4-D was detected in indoor air and on all surfaces throughout the home. The material was tracked inside by pets and home owners. Once inside, stirred up dust kept recirculating the 2,4-D. The highest levels were in the range of 2.5-10 microns, which is in the critical size for particles that a human can inhale.

The estimated indoor exposure levels for young children from non-dietary ingestion can be as high as 10 micrograms/day from contact with floors, and 30 micrograms/day from contact with table tops. By comparison, dietary ingestion of 2,4-D is about 1.3 micrograms/day.

The herbicide 2,4-D is a primary ingredient in Killex, Weed N'Feed and many other commonly used weed control products you can buy at your local garden or hardware store. 2,4-D is also the main ingredient in commercial lawn sprays. ☼

A Building Envelope Test Hut for Coastal BC

The B.C. leaky condo crisis has reinforced to the BC building industry the fact that the West Coast rainforest climate is one of the most demanding building environments in the world. Even so, there is still little information on the long-term performance and durability of the many building envelope designs, materials and assemblies currently being used.

Researching and filling in these gaps is ongoing, but is hampered by the lack of permanent facilities for performance testing. Facilities have been built at the Forintek laboratories in Vancouver, but these are in an indoor laboratory, providing valuable, but limited information. That is why a second test facility operating under real exposure conditions is to be built. The Building Envelope Test Hut will be a permanent test facility that will allow building envelope test assemblies to be mounted into the base building and left exposed to the weather for extended periods while performance data is collected from a sophisticated instrumentation system.

The BC Institute of Technology is refining the conceptual plans for the facility and identifying potential research capabilities, demands and needs that could be served by the facility. ☼

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Letters to the Editor

Congratulations on Your 100th Edition

In your article on the Leaky Condo Legal Update, you make reference to letters of assurance required in the BC Building Code. It should be noted that these letters were introduced in the 1992 version of the code and therefore were not a requirement when Delta issued the permits for the Riverwest project.

Grant Acheson
Manager of Inspection Services
Abbotsford, BC

Thanks for pointing this out. However, some municipalities were using letters of assurance prior to their incorporation into the building code in 1992.

Congratulations on your 100th issue. I can imagine how this publishing venture has not been as lucrative as you once hoped but I have always appreciated receiving Solplan Review. I like your perspective, the range of material that you cover, and the unapologetic Canadian content. I am also impressed with the technical accuracy of your articles.

Here's to another 100 issues (if you can afford it).

Don Fugler
CMHC Research Division
Ottawa

Thanks for the kind comments. Yes, the Economic issue is a sore point. However, by now it's become a bad habit, so I carry on.

The Benefits of Ventilation

Unsolicited testimonial letters often give you much more than extensive research and expensive promotion can. The following is the text of a letter a Vancouver ventilation contractor received. It says much more, and from the heart, than any advertising could. If any one has doubts about the need for effective ventilation, this letter should dispel them. And with this information, is the economic payback argument valid?

Dear......

We would like to tell you how pleased we are that we installed the Heat Recovery Ventilation System in our home.

Since the installation of the HRV system eighteen months ago, we have noticed the following changes:

The eczema that plagued me for many years disappeared within weeks of the installation of the HRV system and has not returned.

The duration and frequency of colds/flu in my family was reduced.

Our home feels warmer in the winter and cooler in the summer.

Although we opened our windows frequently before the installation of the HRV system, the air quality with the HRV is much improved.

There has been a significant reduction in the amount of moisture on our windows and window frames.

We recommend the installation of the Heat Recovery Ventilation System.

L.H., Burnaby

Continued from page 13

changes may affect housing design. As Friedman points out, the demographic shift in society means that there are many more people who don't fit the stereotypical family of mom and dad with a couple of kids.

A particularly valuable section is the discussion of the surveys conducted after families moved in. Because of the wide interest the Grow Home concept received, and its academic connection (Friedman is still a professor at McGill), a number of the early projects have been studied and residents have been interviewed three or four years after having moved in. Not only was general resident satisfaction surveyed, but also the kinds of changes occupants made, and their comments about the design and function of the original construction. This type of occupant survey seldom takes place.

Friedman continues to promote the Grown Home idea in his work with students and on the lecture circuit.

This is very worthwhile book for any designer, developer or builder. ☼

Energy Answers

Rob Dumont

What is an appropriate indoor relative humidity for Canadian houses?

In the Canadian "Exposure Guidelines for Residential Indoor Air Quality," Health Canada recommends an interior relative humidity between 30% and 80% in summer, and 30% and 55% in winter.

What happens if the relative humidity is below 30%?

If the humidity is too low, long periods of low relative humidity are believed to cause dryness of the skin and mucous membranes, which may lead to chapping and irritation. Many people will complain about dry throats and nasal passages. Some species of bacteria and viruses also thrive at low humidity levels. Health Canada Guidelines also state: "The evidence suggests that humidity levels should be maintained between 40% and 50% to reduce the incidence of upper respiratory infections and to minimize adverse effects on people suffering from asthma or allergies."

How low can the humidity go in Canadian homes?

The Canadian Exposure guidelines state that "Relative humidities in Canadian homes have been found to range from 21% to 68%."

However, we have measured indoor relative humidity levels as low as 4% in winter time. Yes, 4%! This occurred in a multi-unit residential building here on the prairies ventilated with outside air at a rate of 39 L/s (83 cfm) per suite. Most of the suites had only one or two occupants, and the high ventilation rate brought in so much dry outside air that it desiccated the suites (and the occupants). It was so dry in the building that the occupants could almost spit grasshoppers!

In cold winter weather, high ventilation rates will easily lower the indoor relative humidity below 30% in most parts of Canada. Cold outside air cannot hold nearly as much water vapour as warm air. For instance, outside air at a temperature of 20°C can hold a maximum of about 15 grams of water vapour per kilogram of dry air, However, at 0°C, outside air can only hold about 4 grams of water vapour per kg of dry air; and at -20°C, the amount drops to 0.6 grams. When this dry air is brought inside, either intentionally via a ventilation system, or unintentionally through building envelope leaks, the indoor air will drop in humidity. Sources of moisture inside the house such as people, cooking, bathing, plants, pets, gas ranges, candles, hot tubs, etc., will humidify the house air somewhat.

Given that Health Canada guidelines recommend 30% minimum relative humidity in winter, are most houses able to maintain that humidity?

A footnote in the Health Canada guidelines reads as follows: "30% relative humidity in winter–unless constrained by window condensation."

Here in Saskatoon, our average outdoor temperature is -18°C in January, and temperatures will fall on occasion to as low as -40°C. At those air temperatures, most older houses with standard double glazed windows will readily frost on the inside if the interior humidity is 30%. Thus, most houses in our climate will not be able to sustain a 30% relative humidity during the coldest period of winter. Thus, relative humidity values in the low 20% range are often found in conventional houses here during the winter.

How can you safely raise the relative humidity in houses in cold winter climates?

Better windows with higher thermal resistance values are key. It also helps if the house has an R-2000 quality air-vapour barrier, which can prevent concealed moisture condensation in walls.

If necessary, humidifiers can be used to raise the humidity levels, but these should be used with extreme care. Here are three points to note about humidifiers:

1. Standing water in humidifiers can quickly become a source of bacteria.
2. Many humidifiers will release salts present in the water into the air of the house, creating a white dust near the humidifier. Dust is generally not a healthy substance to breathe.
3. It takes energy to humidify air.

A low-tech way to humidify your house is to use an interior clothesline and let the moisture from your clothing do the humidifying.

Some heat recovery ventilators use desiccant wheels or paper cores that can recycle moisture from the outgoing air back into the fresh outside air entering the house. Such HRVs have not been popular in colder climates, however, because the units are prone to freezing. Elaborate pre-heaters are needed with that type of heat exchanger to make them work in very cold climates.

A humidifier we have found to work in our home is a table top model that uses a rectangular

shaped wick of small diameter wood fibers that draws water out of a reservoir. Air blowing through the top part of the wick draws water from the wick and into the house air. The advantage of the wick-style humidifier is that the normal salts in the water remain in the wick and do not contaminate the air. The downside of this humidifier is that it has to be manually refilled, and needs about two or three wicks each winter, as the salts eventually clog the pores in the wood fiber wick. We normally let the humidifier go dry every day so bacteria will not grow. Cleaning the humidifier once a week or so also seems advisable.

Where can I buy a decent relative humidity indicator?

The best lower cost units that I have seen (and purchased) are battery driven digital units available at the bigger lumberyards and building hardware suppliers. I recently purchased a digital temperature and relative humidity sensor for about $30 including tax. I cross-checked the unit with our sling psychrometer, and it agreed quite well.

What problems are associated with too high a relative humidity in the summer time?

Again, to quote Health Canada, "Humidity levels above 50% have been found to increase the population size of moulds, fungi and mites (dust mites) that may cause allergies." And "High humidity at high temperatures leads to increased sweating and a loss of electrolytes from the blood; prolonged exposures may lead to heat exhaustion or heat stroke."

Relative humidity is one of those parameters like temperature that should be controlled within a relatively narrow band–neither too high nor too low, but just right. If only the story of Goldilocks had included a section on relative humidity!

Editor's note: Relative humidities of 65% to 70% are regularly measured in small homes and apartments in the Vancouver area, most of which have no functioning ventilation systems. Because of the mild but wet winter conditions of the local climate, indoor humidities can be maintained in the 50%-55% range with a properly designed and operated ventilation system. Humidities will rarely drop below 35%.

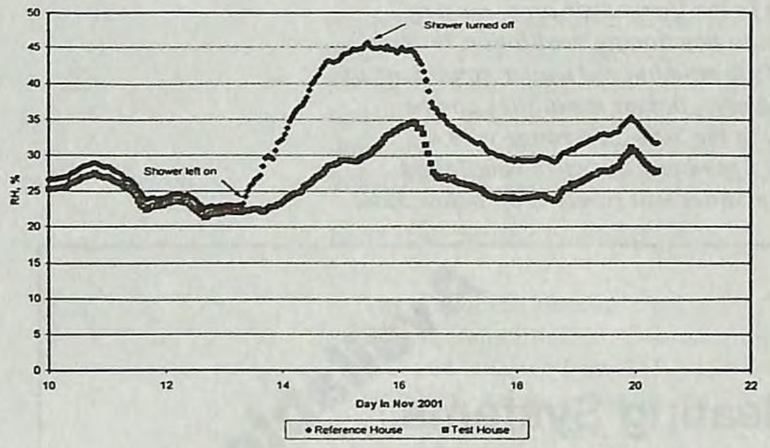
NRC·CNRC

Shower Power: Can You Heat Your House by Running the Shower?

By M.C. Swinton and L. Saint-Martin

During prolonged power outages in the wintertime, such as was experienced during "Ice Storm" in 1998 in eastern Ontario and parts of Quebec, people might wonder if they could heat their gas-heated houses by running the shower. They might also wonder what the humidity build up would be if they needed to try this in an emergency. Well, the Canadian Centre for Housing Technology (CCHT) now has the definitive answer.

The Centre features two identical houses – the Reference House and the Test House – that are used to assess energy-efficient devices in side-by-side house testing, by putting a device in one house and monitoring both to measure the difference in performance. One of the most interesting features of this full-scale facility from the point of view of research and testing is the simulated occupancy system that operates all major appliances and fixtures such as sinks and showers on a fixed schedule to duplicate human activity.



Effect of continous shower on indoor relative humity
Top curve is the test house, the bottom the reference house

Mike Swinton and Luc Saint-Martin are research manager and business manager, respectively, of the Canadian Centre for Housing Technology. The Centre, located on the grounds of the National Research Council's Institute for Research in Construction (IRC) in Ottawa, is operated under a partnership between NRC, CMHC, and NRCan. Mike Swinton is also Acting Director of IRC's Building Envelope and Structure research program.

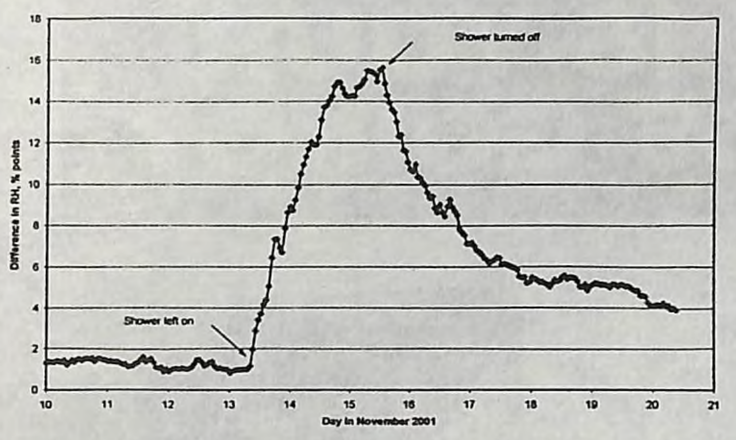
After 3 ½ months of trouble-free operation at CCHT, a tap in the Reference House missed its signal to "turn off" after the 5-minute morning shower on Tuesday, November 13, leaving the shower in the "on" position for 48 hours. At the time, the two houses were being operated identically, in the "benchmarking mode," in preparation for an experiment. This accidental breakdown allowed researchers to perform a thorough analysis of the performance of both houses during the long shower. Unfortunately, the houses are "visited" less frequently under operating conditions to avoid disruptions and the "mishap" was only discovered on Thursday morning, November 15, during a routine "spot check" from a remote location. Surprisingly, the hot water heater was able to keep up, delivering 58°C (136°F) water over the 48 hours of continuous operation. When the gas consumption in both houses was analyzed for water heating and space heating, it was found that space heating in the house with the full-time shower had been reduced by a significant amount.

On the full day of continuous shower operation (Wednesday), the average outdoor temperature was about 10°C, on a mainly overcast day. Given these mild conditions, the shower was able to supply about 60% of the space heating needs of the house for the day. But the useful space heating delivered by the shower was not nearly as much as the increase in the hot water bill. When the two numbers were compared, it was found that only about 9.5%* of the added water heating bill had been converted to useful space heating (i.e. the reduction in space heating in the house with the shower, over the same period). Another way of looking at it is that more than 90% of that extra heat for the shower was going down the drain.

The total amount of natural gas consumed on that Wednesday was about twice the amount needed for space and water heating on the coldest day last winter. This finding reinforces a point found earlier in our CCHT COMBO project: in energy-efficient houses, such as R-2000, an appropriately sized water heater has more than enough capacity to supply both the space and water heating needs of the house – provided that a heat exchange coil is used to transfer the heat instead of the shower!

Another interesting information by-product of this unplanned experiment was the profile of the indoor relative humidity during this period. The RH sensor is located in the hallway about 2 m from the master bedroom, and the shower is in the ensuite. At that location, the RH climbed steadily for about 30 hours while the shower was on, so it was more than 14% RH points above that in the Test House, after which it stabilized. Because of the moisture storage capacity in construction materials, the RH was still higher compared to that of the other house five days after the shower was shut off. (See the two figures.) Note that in a house without continuous mechanical ventilation; for example, during a power failure, and in coastal regions where dry outdoor air can't be counted on to dilute the moisture from the shower, the impact of humidity build-up on the second floor would be even worse.

By coincidence, CCHT is planning to look at a heat recovery system for drains this winter, designed to improve shower performance and water heating efficiency.



Difference in relative humity between the two houses.

* The original work at IRC on this subject was published in 1984 [*Net Energy Contribution of Domestic Water Use to House Heating Requirements*, by S.A. Barakat, Building Research Note No. 209, 1984]. The author reported 9.9% heat recovery for space heating from general hot water use under similar conditions (fall operation, in Ottawa, with very heavy water use) – a near perfect match to our result. Many other scenarios and conditions were investigated in that study.

Coming Events

February 24-27, 2002
CHBA Annual Conference
Victoria, BC
Tel: 905-954-0730
Fax: 905-954-0732

March 6-8, 2002
World Sustainable Day 2002 Conference and Trade Show
Wels, Austria
Tel: 43-732-6584-4386
Fax: 43-732-6584-4383
www.energyglobe.at

March 24-26, 2002
Green Building Conference
Seattle, WA
Tel: 888-602-4663
www.nahbrc.org
Fax: 301-430-6183

April 18-19, 2002
CIPHEX 2002
Calgary, AB
Tel: 416-695-0447